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A STUDY OF PERSONAL DEFENSE WEAPONS FOR U.S. ARMY HELICOPTER PILOTS

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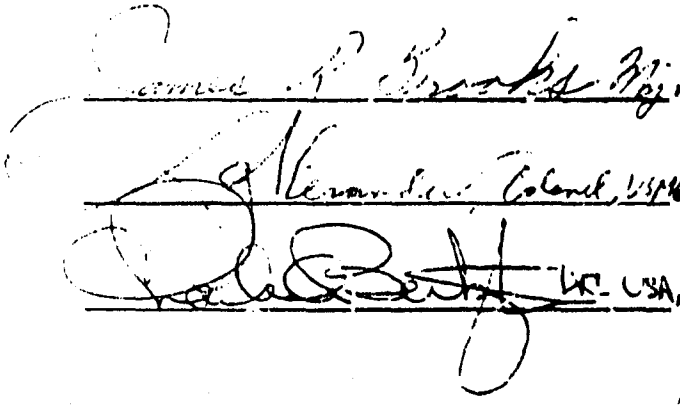

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The opinions and conclusions expressed herein are those of the individual student author and do not necessarily represent the views of either the U.S. Army Command and General Staff College or any other governmental agency. (References to the study should include the foregoing statement.)

ABSTRACT

A STUDY OF PERSONAL DEFENSE WEAPONS
FOR U.S. ARMY HELICOPTER PILOTS

BY MAJOR RAY S. LEUTY

The study problem is centered on identifying existing requirements for a U.S. Army helicopter pilot's personal defense weapon and determining what weapon will best satisfy recognized needs. The purpose of the weapon is determined to be for defense, survival and psychological security.

Physical and performance criteria identified in the study dictates that the weapon must be a pistol. An evaluation is made of various pistols to determine the best available weapon capable of fulfilling the requirement. The 9mm Colt Model 1971 is selected. A discussion and evaluation is made of ammunitions and marksmanship techniques that could improve the weapons effectiveness and hit probabilities.

ABSTRACT

This study was undertaken in response to a United States Army Combat Developments Command requirement to identify the existing requirements for improved personal defense weapons for the various branches and services of the U.S. Army, to include U.S. Army Aviation. The Colt Model 1911A1 .45 Caliber Automatic Pistol has been the standard personal defense weapon of issue for nearly sixty years. With the advent of the helicopter as a viable combat vehicle, its pilots turned to a variety of personal weapons in a form of protest against the 1911A1's weight and inaccuracy. In 1965 the .38 caliber revolver was adopted as the pilot's weapon of issue. Although more acceptable to the pilot than the 1911A1, it, too, was found to be inadequate.

The problem resolved by the research centered on identifying the existing requirement for a helicopter pilot's personal defense weapon and determining what weapon will best satisfy recognized needs. The sequence followed in the research first determined the need for a pilot's PDW by identifying the purpose of the PDW as an emergency use weapon and its intended uses as being for the purpose of defense, survival and instilling a sense of psychological security.

A determination of the weapon's performance criteria is made by identifying necessary characteristics of a weapon that will provide the capabilities required for intended uses. The necessity for insured access to the weapon requires that it be attached to the body. The factors of size and weight then dictate that the weapon must be a pistol.

A comparative evaluation is made between the revolver and the automatic pistol with the automatic being designated as the more suitable weapon for military use. Four automatic pistols are then selected for a comparative evaluation to determine the weapon best capable of fulfilling the pilot's needs. A discussion and evaluation is made of ammunitions and marksmanship techniques that could improve the weapon's effectiveness and hit probabilities.

Two basic conclusions of the research are that an automatic pistol is the most suitable weapon available for a pilot's personal defense weapon, and that the Colt Model 1971 Military Pistol firing a 9 millimeter cartridge is the presently available automatic pistol most capable of meeting the pilot's needs.

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CHAPTER I

INTRODUCTION

> Not too many years ago most of us read opinions, frequently expressed in the Sunday pictorial sections of newspapers, news magazines, and even some service journals, that the day of the foot soldier and small arms was nearly over. Some of these opinions intimated that the expenditure of ten cents on the development of or procurement of new small arms would be a flagrant waste of the tax payer's hard-earned money. Recent events in Southeast Asia, which unfortunately could occur in many other areas of the world, bear out the wisdom of those who turned a deaf ear to the siren song of saving the taxpayer's money by ignoring the development and manufacture of conventional weapons. No rational individual denies the necessity of the maintenance and further development of an overawing nuclear power: a necessary adjunct to that power is the maintenance of strong ground forces armed with the most modern conventional weapons, and small arms are the base upon which the larger conventional weapons are built.[1]

BACKGROUND

In December, 1961, the 57th Transportation (Helicopter) Company arrived in Vietnam. For the first time helicopters were to be employed in force to move troops behind or onto the flanks of the enemy in his own

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[1]Joseph E. Smith, "Preface to the Seventh Edition," Small Arms of the World, by W. H. B. Smith and Joseph E. Smith (7th ed. rev.; Harrisburg, Pennsylvania: The Stackpole Company, 1962).

territory.[2] During the early stages of the war, the pilots of these helicopters carried, as personal weapons, a wide variety of sidearms, ranging from the heavy .44 magnum revolvers to the easily concealed .25 caliber Derringers. For various personal reasons, primarily inaccuracy and weight, most pilots preferred to leave behind the issued .45 caliber automatic pistol.[3] This situation persisted until 1966 when restrictions were implemented to prevent the entry of privately owned firearms into the country. An additional change was made in late 1965 and early 1966 when Army aviators were authorized caliber .38 special revolvers, in exchange for the .45 caliber automatics.

The vacillation resorted to in Vietnam, with regard to the pilots' individual weapons situation, should be avoided in future conflicts. The helicopter is no longer unique in combat, nor its pilots second-class soldiers. Both should be adequately equipped and armed to perform expected missions in future wars.

JUSTIFICATION OF THE STUDY

The Commanding General, United States Army Combat Developments Command (CDC) has directed CDC elements to

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[2]Major Milton P. Cherne, "A Page in History," United States Army Aviation Digest, IX (May, 1963), 17.

[3]Statement by Major James R. Elliott, (Former Section Leader, 57th Transportation Helicopter Company, 1963), personal interview, March 24, 1972.

identify the requirements for personal defense weapons that exist within each of the branches and services of the Army, and to determine if replacement of currently issued personal defense weapons is necessary. The Combat Developments Command Army Aviation Agency (USACDCAA) has indicated that a requirement does exist for a new personal defense weapon (PDW) for pilots. The Aviation Agency has stated that they have ". . . closely monitored developments in the area of personal defense and survival weapons. This interest is fostered by the lack of a weapon adequate to the needs of aircrewmembers."[4] To date, however, the Aviation Agency has not been able to positively identify the PDW requirement to the extent of reducing it to writing.

The author was unable to find previous studies or documents relating specifically to personal defense weapons for helicopter pilots. Combat Developments Command records do not indicate previous complete studies on this subject. The United States Army Small Arms Systems Agency (SASA) has no record of related projects. SASA's PDW project director stated that one of the more frustrating aspects of the PDW project is the lack of valid documentation of historical data, especially from users in combat. An inquiry to the PDW project officer, Office of Doctrine Developmen

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[4]United States Army Combat Developments Command, Aviation Agency, "Memorandum, Subject: Replacement of .45 Caliber Pistol as the U.S. Army Standard Side Arm" (Fort Rucker, Alabama: February 4, 1972), p. 1.

Literature and Plans, U.S. Army Aviation School, Fort Rucker, Alabama, produced only a number of letters and memorandums expressing personal opinions of the writers. A check of the Defense Documentation Center records was unable to produce closely related data from any of the other military services.

Combat Systems Group of Combat Developments Command, senior headquarters of the service agencies to include aviation, has designated the subject of personal defense weapons as an area requiring a thorough examination to determine specific requirements and needs. This research is, therefore, undertaken under the sponsorship of Combat Systems Group and the guidance of a CDC project officer in an endeavor to present an unbiased study on personal defense weapons for U.S. Army Aviators.

STATEMENT OF THE PROBLEM

The problem is to determine: What are the requirements for a helicopter pilot's personal defense weapon and what weapon and ammunition will best satisfy these requirements?

DELIMITATIONS

Personal investigation of weapons and checks of all statistical, mechanical and ballistic data of weapons concerned was not feasible due to time available and costs involved. Reliance upon the opinions of recognized experts in the field of small arms were accepted as valid.

Cost effectiveness is recognized as a dominant

consideration in a decision to purchase a new weapons system. It is not within the scope of this study to attempt to determine the cost effectiveness of any of the weapons examined. Conclusions and recommendations are made without regard to costs involved.

Classified data on small arms were available and were examined as part of this study. In an endeavor to limit the study to an unclassified status, only unclassified sources are referenced. The results of the study would not be different if classified data were referenced.

METHOD OF RESEARCH

The method of research used to conduct this study was the examination of literature on small arms, ballistic data, and helicopter employment; interviews with local veteran combat helicopter pilots and available weapons experts; and attendance at a Personal Defense Weapons seminar.

Sources of literature were the Defense Documentation Center, CGSC Library, Northeast Missouri State University Library, Linda Hall Library at the University of Missouri at Kansas City, Combat Systems Group of Combat Developments Command, United States Army Small Arms Systems Agency and books and magazines personally purchased by the author.

Author experience served as an additional source of information and assistance in the evaluation of data. The author's experience stems from nine and one-half years

experience as a helicopter pilot, two tours of duty in Vietnam, and approximately 1400 hours of active combat flying time. In the field of weapons, the author's experience has been limited to that of a user, not a technician.

Numerous books, documents and papers on small arms performance and various test results of weapons were surveyed for information that could be extrapolated for application to this study.

In April, 1972, the author attended a Small Arms Systems Agency sponsored PDW seminar conducted at Aberdeen Proving Grounds, Maryland. Representatives at the seminar included technical experts from SASA, Edgewood and Frankford Arsenals, U.S. Army Weapons Command, U.S. Army Aberdeen Research and Development Center, and Human Engineering Laboratories. The classified program included a complete update on the PDW program and a detailed technical review of current developments in ammunition and weapon designs and concepts. One significant problem discussed was that the PDW project is progressing slowly due to the inability to properly and adequately define the needs of the user. This is essentially the same problem as that contained in the problem statement of this study.

ORGANIZATION OF THE STUDY

In solving the problem posed, the author first makes

a determination as to the need for a pilot's PDW. This is accomplished in Chapter II by identifying the purpose of a PDW and its intended uses.

In Chapter III the performance criteria of a pilot's PDW is determined by identifying the necessary characteristics of a weapon that will provide the capabilities required for intended uses identified in Chapter II. The identified characteristics are then used as a basis for discussion of potential weapon types that are within the current state-of-the-art.

Chapter IV makes an evaluation of weapons of the type determined to be best qualified in Chapter III. The evaluation is expanded to include a discussion of ammunitions and marksmanship techniques that could possibly increase the weapon's effectiveness.

Finally, Chapter V summarizes the data previously examined, states conclusions and makes recommendations for implementation and recommendations for future study.

CHAPTER II

DETERMINATION OF THE REQUIREMENT

The term, Personal Defense Weapon, means exactly what the words imply -- a weapon used and relied upon by an individual for his personal defense and protection. Also inherent within the term is the qualification that the weapon is intended to be used for emergency use only. Almost any weapon that can be easily handled and effectively used by a single individual in his own defense would qualify as a PDW. Weapons in the firearms category, such as the rifle, carbine, or sub-machine gun are all individual weapons that could serve equally as efficient for both defensive or offensive purposes. The pistol, however, was specifically designed for self defense purposes, and is not considered as a primary combat weapon. The 1911A1 model .45 caliber semi-automatic pistol is the U.S. Army's current PDW. For Army aviators, the .38 caliber revolver is the PDW of issue.

PURPOSE OF THE PDW

In attempting to select the most suitable weapon for personal defense purposes, a determination must be made as to what purpose the weapon will serve. Obviously, the

most prominent use of the PDW would be for defense of the individual. Under certain given circumstances, the selected PDW could possibly be employed in an offensive role. However, its capability for use in this manner should be considered as an additional benefit of the weapon, but not within its design requirements.

Closely related to defensive actions is the matter of survival. Any weapon used for defensive purposes should have an inherent capability of assistance in sustaining the individual in a survival situation.[5] This would include the shooting of game for food; the intimidation or assassination of an individual in order to seize necessary supplies, equipment, or access to a means of escape; signaling for help; and marking targets or positions.

Lastly, the weapon should be capable of providing the individual with a psychological sense of security. Fear or anxiety may be experienced as a result of either real or imagined dangers, and can cause varying degrees of irrational or unusual behavior.[6] Certainly, an individual that is placed or subject to be placed in a situation that would require the defense of his life against a hostile

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[5]Captain Robert L. Webster, Jr., "Army's New Sidearm," United States Army Aviation Digest, XI (November, 1965), 6-7.

[6]Charles M. Harsh and H.G. Schrickel, Personality Development and Assessment (2d ed.; New York: The Ronald Press Company, 1959), p. 116.

enemy will experience some degree of fear.[7] The same holds true for the individual cast into a situation of survival, especially if the possibility of being discovered by the enemy exists. In situations such as these, a man must have full confidence in his weapon and his ability to use it.[8] A feature article of February 18, 1965, in the New York Journal American states that according to views of psychiatrists and criminologists, a gun is a great equalizer in that "it makes a little man feel big, a stupid man feel clever, a frightened man brave and an insecure man feel sure."[9] Although this statement was not intended for military application, it, nevertheless, is applicable to individual psychological behavior. Behavior may be tempered and sometimes controlled by education, training, and conditioning; but, this training and conditioning serves additionally to reinforce and strengthen the individual's confidence.[10] It could be concluded that the more training an individual is given in the operation, functioning and firing of his weapon, the more confident he will become in its effectiveness. At the same time, the user will become more

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[7]Colonel Charles Askins, The Pistol Shooter's Book (Harrisburg, Pennsylvania: The Stackpole Company, 1953), p. 171.

[8]Colonel Townsend Whelen, Small Arms Design and Ballistics (Plantersville, South Carolina: Small Arms Technical Publishing Company, 1945), p. 346.

[9]Carl Bakal, The Right to Bear Arms (New York: McGraw-Hill Book Company, 1966), pp. 88-89.

[10]Harsh and Schrickel, op. cit., p. 110.

knowledgeable of existing inadequacies or faults of the weapon. Therefore, for the user to be confident in the security provided by his weapon, it must be dependable and adequate for the need.

PROBABILITY OF USE

Helicopters have proven themselves in a guerrilla environment. Tactics and techniques currently are being developed to effectively use their capabilities to the fullest extent on a conventional battlefield. Both advocates and adversaries of the helicopter have presented endless arguments concerning the effectiveness of the airmobile concept in a conventional war. Such arguments remain unsupported, however, because such a war has never been fought. But, regardless of the success or failure of the airmobile concept per se, it should be rather obvious that the helicopter itself will continue to be extensively used on any type of battlefield. Helicopters provide the largest majority, indeed almost the total, of Army Aviation's capability to provide continuous support to the five functions of ground combat. These five functions are Command, Control and Communications, Intelligence, Mobility, Firepower, and Combat Service Support. The helicopter's inherent mobility will prove to be of great value to combat support and combat service support operations in the rear areas, irrespective of its active combat envolvement on or forward of the line of contact.

Regardless of the type of war in which engaged, the pilots of rotary wing aircraft will be given the tasks of accomplishing a wide variety of missions. In a conventional war, the preponderance of these missions will likely be conducted in the relatively secure areas located on or to the rear of the front lines. Sorties flown behind enemy lines will probably be comparitively few and, of necessity, short in duration.[11]

By comparison, in a guerrilla war, the helicopter pilot is essentially, at least potentially, in enemy territory as soon as he crosses over the protective barriers of the outer perimeter of his airfield or helipad. Due to the lack of definitive lines of friendly or enemy locations and the extreme difficulty to distinguish between friend or foe, almost anywhere he may fly is, in essence, enemy territory.

Irrespective of the battlefield environment, as long as the helicopter pilot remains in flight, the probability of his requiring a PDW is virtually zero. The helicopter is his "weapon", and its effective employment to accomplish the mission is his primary concern. If, for one of many possible reasons the helicopter is incapable of further flight and unexpectedly forced to the ground in enemy territory, the pilot's interest is immediately shifted from

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[11]Colonel DeLyle G. Redmond, "The Role of Helicopters... In Conventional Warfare," United States Army Aviation Digest, XVIII (January, 1972), 7-9.

mission accomplishment to survival, defense, and assistance or rescue. This is where the tangible need for a PDW is most evident.

EXPECTED USES

The helicopter might be forced down in enemy territory for causes resulting from enemy action, mechanical failure, weather, fuel starvation, or the pilot's decision that a landing is necessary. Regardless of the reason or expected frequency, occasional forced landings in enemy held areas are a reasonable certainty.

If the pilot is downed to the rear of friendly lines or in close proximity to friendly troops, the PDW is likely to serve only as a means of psychological security. Although the weapon may never be used, it, nevertheless, serves a basic but very real need. An individual must feel that he has at least some means of protecting himself against the possibility of harm from the danger that he perceives. Additionally, if he feels confident in the adequacy of that means of protection, he is more apt to remain calm in his actions and exercise good judgement in solving the problem at hand.

If the pilot is downed behind enemy lines or in close proximity to the enemy, the PDW is more likely to serve as a direct means of defense and possible assistance in escape, evasion and survival. It is conceivable that the rapid rescue of a downed helicopter's crew would negate the

necessity for a weapon by the crewmembers. When operating in the vacinity of known enemy positions, helicopter forces are usually employed in teams of two or more aircraft. When a helicopter goes down, its status and position is reported by the pilot of another helicopter operating as a part of the team. Under most circumstances, rescue and recovery operations are initiated immediately, but a quick pickup of the downed crew cannot be assured. Terrain, weather, enemy situation, physical condition of the downed crew, and load carrying capabilities of the rescue helicopter are all determining factors. Unfavorable conditions in any one area could cause delay or complete abandonment of the rescue effort.

Under circumstances such as these, it is imperative that the downed pilot possess a firearm. Under fire, the possession of a weapon can have a great psychological influence on an individual's behavior, even if that weapon is completely outclassed by weapons of the enemy. Conversely, a weapon can also have a modifying effect on the enemies' actions, regardless of his superiority in numbers or firepower. If the downed pilot is believed to be unarmed, the enemy will likely become much more aggressive in efforts to kill or capture the aviator. One shot, however, will usually cause the enemy to take some degree of caution, and, perhaps, provide the few vital seconds necessary for escape.

It can be determined then, that the requirement for a PDW and the probability of its use will increase

proportionally to the degree of probability of the enemies' presence in the vacinity of the downed aircraft. Regardless of the degree of probability of use, a weapon must be provided that will be reasonably adequate for emergency use for defensive and survival purposes. The sense of psychological security and confidence afforded by a reliable weapon also provides many intangible, but very real, benefits.

CHAPTER III

DESIGN CRITERIA

Certain characteristics such as durability and reliability are common to all military weapons. Other physical and performance characteristics are specifically designed into a weapon based on its proposed use. To be operationally acceptable, a pilot's PDW must be capable of fulfilling proposed uses identified in Chapter II. To accomplish this, required characteristics must be identified.

PHYSICAL CHARACTERISTICS

For the PDW to accomplish its intended purpose, it must be readily accessible to the pilot. It is obvious that unless the weapon is in his possession, it can be of no value. There are occasions when it is necessary for the pilot to exit the aircraft so quickly that all he takes with him is that which is attached or within his grasp as he goes out the door.[12] The existence of flames or the threat of flames occurring will cause near panic in the minds and actions of almost any pilot that has witnessed an aircraft fire. The magnesium fuselage of the helicopter

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[12]Statement based upon personal experience of the author.

can become totally engulfed in fire in a matter of seconds. Even the hastiest of exits is sometimes too slow to escape severe burns.

Equally as frightening is the experience of being forced down in the presence of enemy weapons fire. Speed is of essence when enemy bullets are snapping through a disabled aircraft. One dares not hesitate to search for a weapon stowed in some remote area of the cockpit.

Any rational individual that is assured of facing an armed enemy desires to have the most lethal, accurate and reliable weapon possible in his possession. Some form of machine gun would possibly be his first choice; but, it is not feasible for every soldier to carry a machine gun, certainly not a pilot. A semiautomatic rifle or a submachine gun would serve the purpose of a personal defense weapon quite well; but, it would be impractical for a pilot to have one strapped to him at all times.

A rifle, carbine, or submachine gun would be desirable if it could be secured in some location of the aircraft where it could be easily and quickly seized when needed. However, a test conducted at Fort Rucker, Alabama, using ten types of aircraft, determined that there was no suitable location on any of the aircraft for attaching weapons of the type listed. Four of the six aircraft used in the test were helicopters and two of the helicopters were of the UH-1 "Huey" and CH-47 "Chinook" models. The test further concluded that there was no suitable way of

attaching these weapons to the pilot.[13]

Considering the preceding paragraphs, it can be determined that a pilot's PDW must, of necessity, be small enough to be carried on the individual. However, should future helicopters have provisions for adequately stowing larger weapons, then the previously discussed rationale would require reevaluation. Even then, it appears that the best means of assuring the availability of an emergency use weapon is to attach it to the person.

If the weapon is to be carried on the body of the pilot, it must be limited in weight. Numerous complaints have been made about the heavy weight of the model 1911A1 .45 caliber pistol in relation to the usage factor of the weapon.[14] The .45 weighs approximately 2.4 pounds with an empty magazine and 3.0 pounds loaded.[15] A compact weapon that is to be strapped to the body and then forgotten until needed should, at least, not exceed the weight of the Colt .45.[16] Any weight reduction below the .45's three pounds would substantially enhance acceptability of the weapon

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[13]Ralph L. Holloway, Limited Service Test of Small Arms Weapons Systems (SAWS) for Use as Individual Weapons by Army Aircraft Crewmembers, USATECOM Project No. 8-5-0400-06, Final Report of Test (Fort Rucker, Alabama: Department of the Army United States Army Aviation Test Board, [n.d.]), p. iii.

[14]Askins, op. cit., p. 332.

[15]Department of the Army, FM 23-35, Pistols and Revolvers, September, 1971, para. 5.

[16]Whelen, op. cit., p. 324.

by the user. However, the weight of the pistol assists in countering recoil forces; therefore, weight reduction can reach a point of diminishing returns.

A Human Resources Research Organization (HumRRO) report concerning the .45 caliber pistol determined that if an individual perceives a better than remote probability of meeting the enemy, he is willing to accept the weight and discomforts of a better weapon.[17] But, the recognized purpose of a PDW is for emergency use only. Since emergencies are not predictable or common occurances, few people will be willing to habitually carry excess weight that is not likely to be of use.

PERFORMANCE CHARACTERISTICS

The United States Army Small Arms Systems Agency has been unable to find a practical replacement for the pistol within current technological design capabilities.[18] Since the present state-of-the-art for weapons has not reached a Buck Rogers ray gun capability, it appears that the size and weight limitations for a personal defense weapon would necessarily dictate a pistol style of firearm, in

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[17]James W. Dees, "Position Memorandum, Subject: Utilization of the Colt .45 Caliber Pistol as the Personal Defense Weapon for Aviators" (Fort Rucker, Alabama: Human Resources Research Organization, Division No. 6, February 3, 1972), p. 1.

[18]Statement by Bruce W. Jezek (PDW Project Director, USASASA), personal interview, April 4, 1972.

spite of the pistol's inherent accuracy and range limitations.

To be effective in emergency situations, a PDW must be capable of being quickly and easily employed. The speed with which a weapon must be employed is related directly to the range of the threat, assuming that the enemy presents a threat.[19] An enemy at one hundred yards, even with his own weapon at the ready position, allows a fraction of a second longer for reaction than does an enemy at fifty yards. If cover is available for protection, even more time is available. Additional factors may alter or influence the reaction time such as enemy fire, accuracy of fire, rate of closure, and number of pursuers; but, the basic amount of allowable time is still in direct proportion to the range and availability of cover.

Regardless of the existing situation, to be effective, a weapon must be capable of meeting the challenge of the worst possible conditions for its intended purpose. The worst possible case for required speed of employment would be to face an enemy at a range of three yards or less with no existing cover. At this distance the weapon must be prepared for action and a shot fired almost instantaneously.

An intrinsic quality of all firearms is accuracy. When the target is only a matter of a few feet away, accuracy

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[19]William H. Jordan, No Second Place Winner (Shreveport, Louisiana: [n.n.], 1965), p. 91-93.

becomes extremely critical. A miss with the first shot at close range could prove to be fatal. Total accuracy is also dependent upon the shooter's marksmanship ability and the quality of ammunition being fired.[20] The components of accuracy, (shooter, ammunition, and gun), are cumulative in that the degree of accuracy the marksman is capable of, with perfect ammunition and a perfect gun, is enlarged by a ratio equal to the same degree of inaccuracy that actually exists in the weapon and the ammunition.[21] The same would be true of any interchange of inaccuracy within these components. The attainment of total accuracy must begin with accuracy of the initial influencing component -- the weapon.

Once the shot is fired and the target is hit, the opponent should be rendered incapable of further threat to the firer. In other words, the weapon must have adequate stopping power. At the relatively close range in which a PDW is subject to be used, its firer must quickly disable the enemy or suffer the probability of his own defeat. A wounded opponent can still be very deadly. During the Philippine Insurrection of 1898, Americans were astounded to discover that a fanatical Moro with two or more .38 pistol rounds in him was still capable of delivering a fatal

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[20]Whelen, op. cit., pp. 345-347.

[21]Robert A. Burmeister, "45 Auto Pistol", Gun Digest, 19th edition, 1965, p. 177.

blow with a bolo knife.[22] An opponent armed with a modern firearm would be far more dangerous than a fanatic with a bolo; therefore, the opponent should be incapacitated quickly.

WEAPON TYPES

Necessary characteristics of a pilot's PDW have been specified as small size, light weight, easily employed, highly accurate, and extremely lethal. Accepting the assertion that a pistol is the most feasible type of existing weapon for a pilot's PDW, an analysis should be made as to the most suitable type of pistol that possesses these identified characteristics.

Revolver versus Automatic

The revolver and the automatic pistol are the two types of pistols most widely used by military and law enforcement personnel. The revolver is characterized by a rotating cylinder containing a series of chambers. Each chamber holds a special size cartridge which is rotated through a system of ratchets and cams to a position of perfect alignment with the barrel prior to firing. Each time the mechanism is operated, a different chamber and cartridge is brought into line with the bore. This system of operation has proven to be highly dependable and efficient. In fact, some gun experts consider a revolver to

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[22]Elmer Keith, Sixguns by Keith (2d ed.; Harrisburg, Pennsylvania: The Stackpole Company, 1961), p. 31.

be more consistently reliable than the semiautomatic.[23]

Malfunctions occur more frequently in weapons as a result of faulty ammunition than for mechanical failure of the weapon.[24] This fact gives credence to one of the revolver's more valuable assets. The proper functioning of the revolver is in no way dependent upon a properly charged cartridge. In shooting a revolver, if a round is weak or fails to fire, a recocking of the hammer will automatically rotate a new round in line for firing. Recocking the hammer on an automatic will do nothing more than allow the hammer to drop on the same defective cartridge when the trigger is pulled.[25]

It should be noted that both revolvers and automatics are manufactured with either, or both, single action and double action features. In a single action method of operation, the hammer must be mechanically cocked as a separate action prior to each shot fired. With a double action feature, a pull or squeeze of the trigger will cock the hammer and release it to hit the firing pin all in one continuous action. A combination of the two types will allow the weapon to be fired by either method. Both methods have their advantages.

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[23] Ibid., p. 195.

[24] W. H. B. Smith and J. E. Smith, op. cit., p. 187.

[25] Ibid., pp. 186-187.

The biggest disadvantage of the revolver is the limited number of rounds that can be loaded into a cylinder at one time, usually six, and the length of time required to reload.[26] This handicap can cause serious consequences in combat.

The potential perils of carrying a six-shot revolver can be derived from a recent story in The Kansas City Times newspaper. The article tells of an Air Force Lieutenant that was shot down over Laos. Two hours after being downed, the Lieutenant came face to face with an enemy soldier. He fired his .38 caliber revolver from an estimated distance of ten feet. The first shot hit its target, two more missed and a fourth round proved fatal.[27] His revolver held only six rounds and it took four of those to down one man. This left him in a situation of having two rounds remaining in the cylinder and no knowledge of what attraction his shots might have caused. Had the Lieutenant been immediately faced by an additional opponent, and his remaining two shots no more effective than the first four, he likely would have become a casualty himself.

In the early 1900's, a half-moon shaped clip was designed for the revolver which would hold three cartridges at a time.[28] This three round clip, if used with a swing

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[26]Keith, op. cit., p. 194.

[27]The Kansas City Times, March 24, 1972, Sec. A, p. 1, cols 5-7.

[28]W. H. B. Smith and J. E. Smith, op. cit., p. 181.

out cylinder system, would allow a fairly rapid reload capability, but even this procedure could be dangerously time consuming considering the necessity for reloading after each six rounds fired. If time permitted, reload could be accomplished after each three round clip is fired. The half-moon clip is a thin half-oval piece of metal that clips three cartridges by their base to the inside arc of the clip. With three rounds attached in this configuration, it becomes a somewhat bulky package and cumbersome to carry an adequate ammunition supply.

The automatic pistol, on the other hand, carries eight to fifteen rounds in a normal magazine, depending on the make of the weapon. One of the biggest advantages of the automatic over the revolver is the capability for an empty magazine to be ejected and a full one loaded in a very few seconds.[29] (Most automatic pistols are actually semi-automatic in that they fire only one round per trigger pull; nevertheless, they are usually referred to as being automatic).

The automatic operation of the pistol is attained by mechanically utilizing the recoil or expanding gases produced by the fired cartridge. The blowback and short recoil actions are the methods most commonly used in modern automatic pistols. In the blowback design, the breech block is held against the base of the cartridge by a strong spring.

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[29]Ibid., p. 207.

The force of the expanding gas pressures pushes the breech block back, extracting and ejecting the fired case and recocking the hammer. As the breech opens, a spring loaded magazine forces a new round into position forward of the breech block. When the breech block reaches its rear most point of travel, the compressed recoil spring begins to move the block forward again. As the block returns to its original position, it strips the new round from the magazine and forces it into the chamber. A pull of the trigger releases the hammer and the procedure is repeated.[30] The short recoil action is similar to the blowback, but the breech bolt is mechanically locked to the barrel, allowing much higher chamber pressures and the firing of a more powerful round. The recoil action of the exploding cartridge forces the barrel and bolt backward. After a short travel of approximately 3/8 inch, the bolt and barrel are mechanically separated, and the bolt continues to the rear. From this point on, the operation is essentially the same as described for the blowback.[31] The standard sidearm of the Russian Army uses the blowback principle, but, the advantages afforded by higher chamber pressures makes the short recoil action more desirable for military uses.

One of the biggest disadvantages of the automatic

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[30]Whelen, op. cit., pp. 108-109.

[31]Ibid., p. 115.

is its inability to continue proper functioning if a weak powder charge is encountered or a misfire occurs. A weak charge will cause the slide action of an automatic to open only part way. Partial opening will cause failure to eject the spent case, failure to cock the hammer, and failure to reload a fresh round.[32] In some cases the new round and spent case may be jammed together causing more serious problems. In event of a misfire, a second pull of the trigger may possibly fire the round. However, a malfunction of any kind, due to defective ammunition, usually requires manual operation of the slide action to clear the chamber and load a new round.

The supposition that the revolver can be employed one handed, but that two hands are required to operate an automatic has been cited as a major advantage of the .38 revolver over the .45 automatic.[33] This is an inaccurate assumption. One handed operation of an automatic can be accomplished as easily as with a revolver, especially if the automatic has a double action capability. Loading and seating of a fresh magazine in an automatic can be achieved by the average man with one hand faster than most men can load the revolver with two hands. The empty magazine is released by the thumb, the weapon stuck in a pocket or belt, or laid on the ground, and a loaded

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[32]W. H. B. Smith, and J. E. Smith, op. cit., p. 186.

[33]Webster, "Army's New Sidearm", loc. cit.

magazine inserted into the weapon. The automatic is then grasped with the hand and the magazine seated by tapping the butt of it against any solid object.[34] The spent cartridges of a revolver can be shook out with one hand and the gun secured in a pocket or belt in a manner similar to the automatic.[35] At this point, however, the revolver must have each cartridge individually loaded into the cylinder, a considerably slower process than inserting a full magazine into the automatic. It is acknowledged that loading individual rounds into a magazine is a more meticulous procedure than loading a cylinder, but an individual armed with an automatic carries preloaded magazines rather than loose rounds.

The strongest argument against one handed operation of the automatic is the inability to operate the slide with one hand. This, too, is erroneous for there are several ways to work the slide one handed. The easiest way is to firmly grasp the slide from the top and place the handle of the weapon against a solid object and pull back on the slide. The slide also may be placed between the knees and the receiver group pushed down. Another method is to place either the front or rear sight against the heel of a boot, or similar object, and push on the receiver group.[36]

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[34]CWO Ernie L. Greening, "Stay Alive With Your .45", United States Army Aviation Digest, XII (April, 1966), 7.

[35]Keith, op. cit., p. 194.

[36]Greening, op. cit., pp. 8-9.

The automatic pistol is alleged to be more susceptible to mechanical failure than the revolver due to the springs being under constant compression when the gun is loaded and ready to fire.[37] This is an incorrect, as well as misleading, comparison. The implication is that the revolver is less dependent upon compressed springs in order to be ready for firing. As a matter of fact, a typical Smith & Wesson revolver has one flat mainspring and seven coil springs that are under stress throughout the life of the weapon. The degree of stress may change slightly when the gun is cocked or fired, but the stress is continuous, nevertheless. Failure of any one of these springs would make the revolver's operation unreliable.[38]

The automatic is a more trim and compact weapon than the revolver and can be carried more comfortably due the the absence of a bulky cylinder.[39] This is a factor of particular interest to pilots of larger size. A man in the 190 pound category fits snuggly into the armored seats of the helicopter. The fit becomes close with the addition of a survival vest and an armored chest protector. It is difficult to carry a weapon around the hips, and added bulk under the chest protector is most uncomfortable.

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[37]W. H. B. Smith and J. E. Smith, op. cit., p. 208.

[38]William Dresser, "Durability of Handgun Springs", The American Rifleman, CXVII (September, 1969), 90.

[39]Keith, op. cit., p. 191.

For the average marksman, rapid fire accuracy is better with an automatic than a revolver. The self-cocking action of the automatic eliminates the necessity to reposition the hand before each shot and allows a lighter trigger pull for the single action operation.[40] A single action revolver will require repositioning the hand before each shot because the thumb must be used to cock the hammer. A double action revolver does not require repositioning the hand to cock the hammer, but the heavier trigger pull will cause the weapon to jump at the moment of firing.[41] This jumping action is a result of the sudden release of the eight to fourteen pounds of muscle tension required to complete the trigger pull. The trigger pull on a cocked automatic is only three to four pounds; therefore, less jump is experienced. If the automatic is one of the double action models, the initial trigger pull will be equally as heavy as the double action revolver, but thereafter, the hammer would be cocked automatically, and the weapon would fire in a single action mode with the lighter squeeze required.

Gyrojet Handgun

The Gyrojet handgun is a type of pistol that is relatively new in concept. This weapon, to date, has not

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[40]Whelen, op. cit., p. 103.

[41]Askins, op. cit., p. 275.

proved effective for military use, but it is believed that the concept is of significant potential to merit mention in this study. The Gyrojet, introduced in 1965, fires a cartridge the same size and shape as the .45 caliber automatic cartridge. The Gyrojet's cartridge is, however, a self-contained small rocket projectile. The bullet is actually loaded with a propellant charge, and when ignited, pushes the bullet forward, continuing to accelerate after leaving the gun. The projectile attains a maximum velocity of 1250 feet per second and has excellent penetrating power. Maximum velocity is attained at approximately forty-five feet. The gun itself weighs twenty-eight ounces and is relatively simple in design. Due to the projectile being self-propelled, there is no recoil from firing. The weapon has some extreme disadvantages in that the ignition of the projectile causes a considerable flash, and the projectile is not accurate. It has practically no muzzle velocity due to the acceleration-in-flight characteristic. Therefore, it would be of little value at very close ranges.[42] A combination of a standard firearm and the Gyrojet principle would be extremely desirable. The round would be fired from a conventional style of pistol to give it initial velocity and spin stability. The rocket thrust of the bullet would give it additional range.

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[42]E. H. Harrison and Walter J. Howe, "Gyrojet Handgun", The American Rifleman, CXIII (December, 1965), 80-82.

Stockless Rifle

The United States Air Force recently tested a new type of weapon dubbed the .221 IMP (Individual Multi-Purpose). The weapon is seventeen inches long and weighs sixty ounces empty, and seventy-six ounces with a thirty round magazine attached. This weapon is relatively new in concept because it is stockless, using the firer's forearm for support. The handgrip and barrel resemble a long barreled pistol; however, the barrel actually extends beyond the rear of the grip to a point behind the wrist. Here the magazine and receiver group are attached. It is this section that is pressed against the forearm for stability. The IMP may be fired semiautomatic or full automatic, depending on the shooter's desires.[43]

In initial tests the weapon seems to be impressive and probably would be a fine weapon for Air Force pilots downed behind enemy lines. But, for U.S. Army helicopter pilots, the weapon does not appear to be practical. In considering the desired characteristics of a PDW, the IMP is too large to be easily attached to the individual, and its weight is much too heavy to be carried virtually unnoticed. According to tests, it can be quickly employed, is accurate, and has adequate stopping power. Targets can be engaged at a greater range than with the pistol, and

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[43]Whit Collins, ".221 'IMP'", Guns & Ammo, XVI (February, 1972), 26-29.

it has greater firepower and ammunition capacity. But, when considering these characteristics, one envisions an offensive style weapon rather than a personal defense weapon to be used in emergencies.

On known high risk missions the helicopter pilot should be afforded the opportunity to carry a weapon of greater firepower than the pistol, but that additional weapon should be an M-16 or CAR-15 rather than a weapon like the IMP. The M-16 and CAR-15 are currently in the U.S. Army inventory, fire a cartridge much more effective than the IMP's caliber .221 Fireball round, and the ammunition is readily available from common sources.

The IMP will probably create a lot of interest and may be adopted for use by Air Force pilots, but it is not the practical answer to an Army helicopter pilot's need.

CHAPTER CONCLUSIONS

The preceding paragraphs identified the indispensable performance characteristics of a pilot's PDW. The weapon must be small enough to be easily attached to the pilot, light enough to be comfortably carried virtually unnoticed for extended periods of time, capable of being quickly and easily employed, have a high degree of accuracy and possess adequate stopping power at close range. These characteristics, particularly size and weight, limit the PDW to a pistol style of weapon.

In comparing the two most common types of pistols, the revolver and the automatic, it is apparent that the automatic is the superior of the two weapons for military purposes. The automatic holds and fires more rounds without reloading, reloads much faster, is more compact in size and shape for easier carriage, and fires faster and easier after the first round. The revolver has one advantage in being capable of continued operation with weak or imperfect ammunition. However, other advantages of the automatic decidedly outweigh this factor. Both weapons are capable of one handed operation and are of nearly equal dependence on springs for proper functioning. Stopping power of the two weapons is dependent upon the ammunition, which will be discussed in the following chapter.

For previously stated reasons, the Gyrojet, the IMP stockless rifle, and the revolver are rejected from further consideration as the pilot's PDW.

CHAPTER IV

EVALUATION OF WEAPONS AND AMMUNITION

The preceding chapter established the automatic pistol as the most suitable weapon available to meet the requirements of a pilot's PDW. This chapter will evaluate selected existing automatic pistol designs, as well as types and sizes of ammunitions available, to determine what weapon and ammunition combination will best meet the performance criteria of the PDW.

WEAPONS

Model 1911A1 .45 Caliber Automatic

There are hundreds of different sizes and styles of automatic pistols made in countries throughout the world. One of the oldest and most controversial of all automatic pistols is the standard sidearm of the U.S. Army, the .45 caliber Model 1911A1. This weapon has endured through two world wars and many other military actions throughout the world. However, as noted in Chapter I, many helicopter pilots in Vietnam, when given a choice, chose not to carry the .45 because of its weight and inaccuracy. The gun's inaccuracy was probably a greater source of dissatisfaction than its weight. It was noted that some pilots carried .44 magnums which weigh approximately forty-eight ounces.

unloaded.[44] As previously stated, the fully loaded .45 automatic weighs approximately three pounds (forty-eight ounces), or about the same as any empty .44 magnum. Considering the unprecedented style of some of the pioneer pilots in Vietnam, the .44 surely carried with it a certain amoun of ostentatiousness. When considered in perspective with the HumRRO report on an individual's willingness to carry a heavier weapon if a good probability of meeting the enemy is perceived, this could be interpreted as indicating a willingness to carry a heavier weapon if that weapon provides a means of fulfilling a need. In this case that need could have been either confidence, security, recognition, or any combination of the three. Regardless, it is fairly certain that the weight of the .45 is not so heavy that its weight alone becomes the dominant factor in the weapon's rejection.

The author was assigned in Vietnam during the period when the .45 automatic was the only pistol available. Regardless of the complaints about the weapon, it was always carried on the missions. Lack of confidence in it was great enough, however, to cause most aviators to carry a rifle beside their seat in addition to the .45. It was also noticeable during this period that very few pilots bothered to test fire their .45 other than when first issued. This

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[44]"U.S. Handguns - Single Action Revolvers", Gun Digest, 26th Anniversary Edition, 1972, p. 245.

was in marked contrast to the situation in 1970 after the .38 revolver was issued. The author was located in an area no more secure than in 1966, but pilots test fired the .38 regularly, and few, by comparison, carried additional weapons. This was attributed to the .38 being a more desirable weapon to fire and the pilot's greater degree of confidence in its accuracy. It seems evident, then, that the most valid complaint of the .45 automatic is its inaccuracy, with a resultant lack of confidence in the weapon.

A large variance does exist in the accuracy of issued .45 automatics. This inaccuracy is primarily a result of the loose fitting tolerances of the barrel and slide assembly. Phenomenal scores can be obtained shooting the 1911A1 automatic, but weapons capable of firing such scores have been accurized by the refitting of a new barrel, barrel bushing, link, and link-pin to tighten the action of the gun. They were also fitted with new sights and more sensitive triggers.[45] The issued model of the 1911A1 is not designed for target shooting; therefore, it is purposely manufactured with loose tolerances so that it will continue to function reliably even when exposed to mud and dirt.[46]

An additional factor in the .45's inaccuracy problem is the shooter's natural tendency to flinch from the heavy

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[45]Burmeister, "45 Auto Pistol", op. cit., p. 180.

[46]M. D. Waite, "M1911A1 Service Pistol", The American Rifleman, CXVII (February, 1969), 62.

recoil of the gun.[47] This flinching is further aggravated by the loud report of the weapon as it fires. The Human Engineering Laboratory at Aberdeen Proving Grounds has determined that flinching from the gun's firing will occur when the sound intensity goes above 140 decibels. The .45 automatic produces a level of approximately 148 decibels. [48]

The sights on the .45 automatic have been criticized as being too small for accurate sightings.[49] The larger fixed sight used on target .45's is the one modification that is practical for the combat .45.[50] In combat the degree of accuracy that would be improved by the addition of larger sights is dependent upon the situation. Accuracy at any range is inversely proportionate to the speed with which the gun is fired.[51] If the shot must be fired quickly at close to moderate range, the fastest method of aiming is by feel or sighting along the barrel alignment. At ranges greater than twenty-five meters, the sights should be used.[52] Since the handgun is the most difficult of all firearms to shoot accurately, the firer needs every advantage

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[47]Askins, op. cit., p. 33.

[48]Statement by Jack J. Boccarossa (Project representative, U.S. Army Weapons Command), personal interview, April 5, 1972.

[49]Burmeister, loc. cit.

[50]Waite, loc. cit.

[51]Jordan, op. cit., p. 93.

[52]Ibid., p. 96.

available. This includes any advantage offered by improved sights.

One of the worst faults of the 1911A1 automatic pistol is its inadequate safety features. The weapon has a safety lock which locks the hammer, sear, and slide in position. The grip safety prevents firing until the handle is held firmly. The disconnector prevents firing until the slide and barrel are locked together. The half cock position of the hammer prevents the trigger from being pulled and precludes accidental firing with a round in the chamber and the thumb safety off. Providing the trigger is not pulled, a hammer that slips off the thumb prior to being fully cocked will stop at the half cock position rather than striking the firing pin. Lastly, the weapon uses an inertia action firing pin that is shorter than the breech block. This means a sharp blow is required to force the pin forward, compress its spring, and strike the cartridge primer cap.

In spite of these numerous safety features, accidental firing occurs far too frequently. The safety lock must be disengaged and the gun handle held tightly in order to operate the slide. In gripping the handle to counter the rearward pull on the slide, shooters will inadvertently squeeze the trigger. When the slide is released and snaps forward, the hammer falls, firing the weapon. Accidental firings also occur when clearing the weapon. The only way of determining if a cartridge is loaded is to pull the slide back and inspect the chamber. This inspection is not always

performed. Instead, it is assumed that the weapon is empty. The magazine is then ejected, and the trigger pulled. The result is a round fired unintentionally. Both methods of accidental firing have been personally witnessed by the author.

Various methods for preventing accidental firings have been designed into other pistols. These include magazine cutoffs which prevent firing with the magazine removed, safety locks that remain effective during operation of the slide, and pins that protrude when a cartridge is in the chamber. The .45 would be a much safer weapon if it incorporated one of these devices.

Browning Model 1935 Hi-Power

The Browning Model 1935 Hi-Power 9 millimeter (mm) automatic is considered by many gun experts to be the best military handgun in use anywhere. It is currently the standard issue pistol of the British, Canadian and Nationalist Chinese Armed Forces.[53] The Hi-Power has excellent characteristics for a PDW. One very distinguishing feature is its thirteen round, staggered box magazine. The capability of firing thirteen rounds before reloading could be a decided advantage in a gun battle. In addition, the Hi-Power weighs thirty-three ounces empty and thirty-eight

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[53]Colonel Charles Askins, (Ret.), "Aging .45 Hangs On", Army Times, February 16, 1972, p. 37.

ounces fully loaded.[54] In designing this pistol, John Browning eliminated the barrel bushing, link, and link-pin that cause so much slack in the .45 automatic. The front of the slide below the muzzle is solid, eliminating the need for a barrel bushing. The principle of the barrel-slide lock is the same as that used on the Colt .45, but the operation of unlocking is much improved. In place of the link and link-pin, the Hi-Power allows the barrel to slide rearward on a guide slot and receiver cam arrangement.[55] This provides a much more rigid barrel support system than the .45, and consequently some degree of increased accuracy. An extra safety feature of the Hi-Power is its magazine disconnector which prevents the weapon from firing when the magazine is removed.[56]

Smith & Wesson Model 39

The Smith & Wesson Model 39 automatic is another highly regarded pistol of potential military use. It fires a 9mm cartridge and weighs approximately twenty-eight ounces with an empty magazine. The magazine capacity is eight rounds. Outstanding features include a double action

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[54]R. Blake Stevens and Jack V. Krcma, "Browning's Last Pistol - The Model 1935 Hi-Power", The American Rifleman, CXVII (July, 1969), 34.

[55]W. H. B. Smith and J. E. Smith, op. cit., p. 237.

[56]Ibid., p. 204.

mechanism, magazine disconnector, and adjustable rear sights.[57] The double action feature can be of significant advantage to the pilot that must draw and fire in a hurry. This feature, as previously discussed, eliminates the need for cocking the hammer prior to firing. Once a round is loaded into the chamber, a squeeze of the trigger is all that is necessary to put the gun into action. The Model 39 uses essentially the same operating mechanism as the Browning Hi-Power with the exception of requiring a barrel bushing. The Model 39 is the standard sidearm of the Illinois State Police.

Colt Model 1971 Military Pistol

The newest automatic pistol of potential military value is the Colt's Model 1971 Military Pistol. The only data available on this pistol, at the present time, is the manufacturer's technical report; however, from an evaluation of the data, the manufacturer appears to have carefully designed the weapon to eliminate most of the former complaints about automatic pistols. The Model 1971 can be manufactured in either 9mm, .38 or .45 caliber. The 9mm and .38 caliber weigh thirty-five ounces with an empty magazine, and the .45 caliber version weighs thirty-four ounces with magazine. It has an overall length of 7.95 inches with a 4.5 inch barrel. The 9mm version weighs

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[57]James M. Triggs, "Smith & Wesson Model 39", NRA Illustrated Firearms Assembly Handbook, [n.d.] [Vol. 1], 64.

forty-one ounces with a fully loaded magazine, but the magazine holds fifteen rounds, (eight rounds more than the 1911A1 automatic and three ounces less weight). In addition to the larger magazine, other new features include a combination of double and single action, allowing it to be fired in either mode. The first round can be fired double action for speed; thereafter, the slide automatically cocks the hammer and additional rounds are fired single action. The Model 1971 incorporates a positive lock safety feature. When the safety is engaged, it places a steel block between the hammer and firing pin, as well as gripping the end of the firing pin. The slide is not locked to the receiver with the safety engaged; therefore, the slide may be activated and the gun loaded with the safety in SAFE position. This will prevent the possibility of accidental discharge while loading or unloading the gun. The absence of a magazine disconnector enables the weapon to be used single shot if the magazine is lost or damaged. The weapon is also made of stainless steel alloys for increased pistol life. An extra advantage of the Model 1971 is the simplification of field stripping. No parts are under tension during stripping, no special tools are required, and it is disassembled into four large parts.[58] This weapon definitely should be worthy of additional investigation and field testing as

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[58]Colt Industries Military Arms Division, "Colt's Military Pistol Model 1971", Colt's Concepts for a Personal Defense Weapon, Technical Report No. 850-2086 (December, 1970), p. 3-2 through 3-11.

a PDW. It is likely to serve equally as well for pilots as other personnel whose duties make carrying a rifle impractical.

AMMUNITION

The United States Army Small Arms System Agency (SASA) at Aberdeen Proving Grounds has been engaged in a Personal Defense Weapons program since 1969. As previously noted, their efforts have failed to produce any new weapon or weapons concept significantly better than the existing .45 caliber 1911A1 automatic pistol. As a result, SASA's efforts are now directed toward trying to provide a better hit probability through development of multiple projectile cartridges. Multiple projectile designs include a salvo squeeze bore system, a segmented bullet concept, and a multiple sphere "shotgun" type round.

Salvo Squeeze Bore

The salvo squeeze bore is a system proposed by Colt Industries that essentially stacks a series of three projectiles one on top of the other inside a single cartridge. The round must be fired through a special barrel that has a tapered smooth bore section at the end. This barrel initially gives each projectile rotational velocity for stability, followed by a squeezing effect on the round which separates the projectiles. The projectiles actually are separated prior to leaving the barrel; thus each

projectile seeks its own path but maintains a predictable pattern. The reduced diameter of the projectiles from the squeezing action increases range and penetrating ability.[59] The system has considerable potential, and the firing of three bullets from one cartridge certainly increases the probability of hitting the target. The fact that each projectile is given individual rotational velocity creates gyrostatic stability for each projectile which provides for greater accuracy.

Segmented Bullet

The segmented bullet is a design that fabricates several lead segments into the standard form of a single bullet. As the round leaves the barrel, the bullet separates into the several segments.[60] This concept does not appear to have as much merit as the squeeze bore system. The segments are not individually spin stabilized because they travel through the bore as one piece and separate after leaving the barrel. As a result, velocity decay is more rapid, and accuracy is not as great as with the squeeze bore.

XM 261 Cartridge

Present primary emphasis of the PDW program is being placed on further development of the XM 261 cartridge

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[59] [Bruce W. Jezek], "Personal Defense Weapons, Summary Report" (2d rev. partial draft, March 28, 1972), p. V-15.

[60] Ibid, pp. V-15, V-16.

for the .45 caliber automatic. This round is similar in concept to a shotgun cartridge and would require modification of the .45 with a smooth bore barrel. Tests are bing conducted to determine the most effective size, number and composition of shot for the round. Field tests with the round have proven so effective that SASA's PDW project director believes the cartridge should be adopted as the standard round for the .45 automatic, and the .45 retained as the U.S. Army's personal defense weapon.[61] While the multiple projectiles increase the probability of hitting the target, the effect of less than the entire shot pattern hitting the target is questionable.

An individual stimulated by the heat of battle and intent on killing his opponent must be stopped by a solid hit. The stopping power of two or three projectiles weighing seven to nine grains each would not be very effective unless a vital organ or nerve is hit. Wounds often go unnoticed in the excitement of combat, and an individual that can be halted or slowed by two or three small pellets would possibly stop his charge from the sound of a weapon firing or bullets hitting close by; but, the probabilities and associated variables of such a situation are so great that it is impractical to attempt to rationalize the effects in this study. A solid hit with

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[61]Statement by Bruce W. Jezek, personal interview, April 4, 1972.

the XM 261 round will undoubtedly stop a man, but a solid hit with a 115 (9mm) or 230 (.45 caliber) grain bullet would probably do the same.

At close range, the kinetic energy displaced to the individual from the total of all shot pellets in the XM 261 would be greater than the amount from a single bullet that passes through the entire mass of the target.[62] Assuming that no vital organs are hit, the wound and resulting shock effect from the XM 261 would be greater than the bullet, but kinetic energy transfer would be reduced by an amount equal to the sum of the pellets missing the target. The greater the range, the greater will be the dispersion of the shot pattern. The larger the shot pattern, the less probability of all pellets hitting the target. A single slug is also less likely to hit the target at greater ranges, but if it does, the full potential of its kinetic energy is more likely to be transferred because the velocity of the projectile decreases with range. The lower the velocity, the less probability of the bullet passing through the mass, hence total energy transfer.

Since the PDW is designed for emergency use, and that use is likely to be at close range, it would seem that the XM 261 round offers an advantage in probability of hit and probability of incapacitation. However, with both shot and slug cartridges, as range increases, the probability of

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[62][Jezek], Personal Defense Weapons, Summary Report, op. cit., pp. IV-3, IV-4.

incapacitation decreases. Assuming the target is hit, the probability of incapacitating the target is many times greater with the single slug.[63]

The greatest disadvantage of the XM 261 cartridge is the necessity for using a smooth bore barrel. This prevents the weapon from being used with bullet cartridges for longer range shooting. A flexibility of cartridge choices would be preferred.

Cutting Projectiles

Studies of multiple projectile cartridges are being conducted concurrently with studies to develop methods of producing high lethality potential. Areas of lethality investigation include research of cutting mechanisms as well as the traditional kinetic energy transfer projectiles. Cutting mechanism concepts that have been designed and tested have not proven to be effective. Theoretical studies on more promising concepts are being conducted.[64]

.45 Caliber versus 9 Millimeter Cartridges

In considering types of ammunition for the PDW, the size of the cartridge must be evaluated. The two cartridges most commonly used in military pistols are the .45 caliber and the 9 millimeter. The .45 caliber is currently used by the United States, Mexico, Norway,

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[63] Ibid.

[64] Ibid., p. I-1.

South Vietnam, and Nationalist China (Nationalist China also uses a 9mm). Virtually all of the remaining major powers of the world have adopted the 9mm as their standard sidearm cartridge. The 9mm has also been adopted as the standard pistol cartridge for nations of the North Atlantic Treaty Organization.

The best 9mm cartridge currently being made was originally designed by the Germans to fit their Luger pistol. The round is commonly referred to as the 9mm parabellum. The bullet of the 9mm parabellum is the same diameter as the .38 caliber; however, the .38 caliber weighs from 130 to 158 grains as compared to the 9mm's 115 grains.[65]

In comparing the 9mm to the .45 caliber, the 9mm has a measured muzzle velocity of 1150 feet per second (fps) to the .45's 860 fps. At fifty meters, the 9mm has dropped to 1020 fps and the .45 to 819 fps. The 9mm has a greater potential stopping power (measured by kinetic energy transfe) up to a range of twenty to twenty-five meters, but due to its high muzzle velocity, it is more likely to pass through the mass, thus not transferring all of its energy. Because of its much lower velocity and heavier slug, thus slower rate of velocity decay, the .45 caliber bullet will possess greater potential stopping power from twenty-five to fifty meters.[66] The 9mm carries approximately 365 foot

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[65]Askins, The Pistol Shooter's Book, op. cit., p. 365.

[66][Jezek], Personal Defense Weapons, Summary Report, op. cit., p. IV-3.

pounds of energy (measured at the muzzle) and will penetrate ten, 7/8 inch pine boards. The .45 carries approximately 378 foot pounds of muzzle energy and can penetrate up to six, 7/8 inch pine boards.[67]

The .45 caliber has an advantage in stopping power, but the 9mm has a much higher velocity and penetration capability. The higher velocity of the 9mm also gives it a flatter trajectory which results in better accuracy and longer range capability.

The biggest advantage of the 9mm over the .45 is its greater accuracy. This is resultant from its flatter trajectory and the much milder recoil of the weapon. With less recoil there is less flinch and greater accuracy obtainable by the shocter. With greater capability of accuracy, the individual possesses more confidence in his weapon, and is more willing to improve his own marksmanship capabilities.

Basic Loads

The number of rounds of ammunition carried by each pilot will vary depending upon the type of mission to be flown and the individual's anticipated probability of need. On the ground within the confines of an airfield or a relatively secure area, one magazine carried in the weapon, assuming a weapon is deemed necessary, is likely to be

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[67]Askins, The Pistol Shooter's Book, loc. cit.

adequate. However, when flying even an administrative mission, it would be foolish not to carry at least one, and preferably two, spare magazines of ammunition. Many pilots in Vietnam, when armed with the .45 caliber automatic, habitually carried two extra loaded magazines in a leather case made to slip on the pistol belt. This provided them with seven rounds in the weapon and fourteen extra rounds for a total of twenty-one rounds. If the need for more than twenty to thirty rounds of ammunition is anticipated, the pilot should probably carry along a larger weapon capable of providing greater firepower than that of a pistol.

Although, as previously stated, the weight of extra ammunition is not of great concern because the cartridges fulfill a perceived need, the combination of weight and bulk of spare magazines is worthy of mention. A .45 caliber cartridge weighs about .75 ounce and a 9mm cartridge weighs about .37 ounce.[68] Fourteen .45 caliber rounds would weigh 10.5 ounces and fill two magazines. Fifteen 9mm rounds would weigh 5.55 ounces and fill one Colt Model 1971 magazine. Two spare Model 1971 magazines would hold thirty rounds weighing 11.1 ounces. The Model 1971 magazine is .268 inch or 6.8 millimeters thicker than the .45 caliber magazine. Thus, with the Model 1971 automatic, two spare magazines provide an adequate supply of thirty extra rounds for a very little more weight and bulk than the fourteen

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[68]W. H. B. Smith and J. E. Smith, op. cit., p. 713.

extra rounds provided by two spare .45 caliber magazines.

SURVIVAL

The survival assistance aspects of a weapon can be greatly increased by the flexibility afforded by a choice of ammunition loads. Ammunitions made for the .45 caliber automatic include ball, tracer, and high density shot rounds. Any weapon adopted for use as a pilot's PDW should have these rounds available plus a flare and birdshot round. Only 9mm ball and tracer rounds are available for the Colt Model 1971. The high density shot, flare and birdshot rounds should be developed to complete the weapons system. Three of each of these rounds would fill a fifteen round Model 1971 magazine. One or two magazines thus loaded and carried in the survival vest would provide the pilot with multiple capability for survival situations.

MARKSMANSHIP

It is acknowledged that the pistol is the most difficult of all small arms weapons to shoot accurately, The weapon is supported strictly by the hands at the end of a very flexible wrist joint. The radius between the front and rear sights is so small, that any degree of alignment error is magnified tremendously at the target. This short sight radius and basic instability make any movement caused by muscle tension during trigger squeeze very critical.

Various methods have been designed to stabilize the pistol. Most are either wrist supports or shoulder supports. The shoulder supports consist of some form of wire or solid shoulder stock attached to the butt of the weapon. The Browning Hi-Power is one of several pistols that has a shoulder stock that can also be used as a holster for the weapon. These shoulder stock/holsters are practical for long range firing but of no value for close range quick-fire shooting. The additional weight and bulk make them undesirable for a pilot's PDW. Wire shoulder supports are not as heavy or bulky, but nevertheless, cumbersome to carry.

The simplest method of support is by the use of a lanyard cord which loops around the neck and into the lanyard loop at the base of the pistol butt. (Not all pistols are made with a lanyard loop.) By straightening the arms and properly adjusting the cord length, some degree of increased stability can be attained. The disadvantage of this method is that it restricts the rapid movement of the pistol from one direction to the other, and the cord is subject to become entangled when slack.

A wrist-lock stock is a practical device that can be of value in increasing accuracy. This is an extension of the pistol butt that protrudes toward the firer and underneath the wrist. When properly designed, it will press against the underside of the wrist just back of the joint. When the hand is bent downward, the wrist is locked into correct position for shooting and a high degree of stability

is realized.[69] This extension is not practical as a permanent part of the weapon, but it is worthy of consideration as a snap-on component.

Human Engineering Laboratory studies have proven that marksmanship training can improve an individual's accuracy up to 50%. However, unless training is continued periodically or the individual fires his weapon frequently, the improvement deteriorates rapidly.[70] In a peacetime environment, a high degree of accuracy is not necessary; therefore, the annual qualification or familiarization firing is sufficient. In time of war, the POR training given is not adequate to achieve proficiency with the pistol. Since the pistol is not often used in combat, maintenance of one's marksmanship ability in the combat zone is left up to the initiative of the individual. As previously stated, the author's personal experience has demonstrated that if an individual has confidence in his weapon and it is a comfortable weapon to fire, the individual will not object to firing frequently enough to maintain his proficiency.

CHAPTER CONCLUSIONS

This chapter has evaluated the operational characteristics of the Model 1911A1 .45 caliber automatic,

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[69]Walter F. Roper, Pistol and Revolver Shooting (New York: The Macmillan Company, 1945), p. 173.

[70][Jezek], Personal Defense Weapons, Summary Report, op. cit., p. V-25.

the Browning Model 1935 Hi-Power 9mm automatic, the Smith & Wesson Model 59 9mm automatic, and the Colt Model 1971 Military Pistol. Of these weapons, the Colt Model 1971 possesses the greatest possibility of fulfilling the requirements of a pilot's PDW.

In the ammunition categories, the XM 261 cartridge possesses great potential for stopping and incapacitating an opponent at close ranges, but loses its potential for incapacitation as range increases. It would be extremely valuable if it could be fired from a rifled barrel and retain its close range capabilities.

The 9mm parabellum cartridge is a more favorable round than the .45 caliber cartridge due to its capability of increased accuracy. It is a more desirable round to fire due to the lighter recoil transferred to the shooter.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The problem which this study was designed to solve is: what are the requirements for a helicopter pilot's personal defense weapon and what weapon and ammunition will best satisfy these requirements?

SUMMARY

The presently issued personal defense weapon for U.S. Army aviators is a .38 caliber revolver. It is an effective and dependable weapon, but possesses design limitations that prevents it from being the best weapon available to fulfill the need.

Requirements of a Personal Defense Weapon

A pilot's personal defense weapon is intended to be used only in emergency situations. Its intended uses are:

1. For the personal defense of the pilot in the event of a forced landing or unexpected encounter with the enemy.

2. Assisting the pilot in a survival situation, either by killing food, intimidation or assassination of the enemy and signaling or marking locations.

3. To instill a sense of psychological security in the pilot by his possession of a dependable and adequate weapon.

The necessary characteristics of a pilot's weapon that will fulfill the requirements of defense, survival and psychological security are:

1. Small enough to be easily attached to the body of the pilot.

2. Light enough to be carried virtually unnoticed for extended periods of time.

3. Capable of being quickly and easily employed.

4. Possess a high degree of accuracy.

5. Possess adequate stopping power at close ranges.

The size and weight requirements of a pilot's PDW limit the weapon to a style of pistol. The two pistols suitable for modern military use are the revolver and the automatic.

Comparison of Weapons

The revolver has one advantage over the automatic in that the revolver will continue to function when firing weak or imperfect ammunition. The automatic's advantages, however, decisively shift the balance in its favor. The automatic's advantages over the revolver are:

1. Holds and fires more rounds without reloading.

2. Reloads much faster.

3. Easier to carry due to compact size and shape.

4. Allows faster and easier shooting after the first round is fired.

Four automatic pistols were selected for a comparative evaluation. They are:

1. The Colt Model 1911A1 .45 Caliber Automatic, selected because it is the only automatic pistol currently in the U.S. Army inventory of weapons.

2. The Browning Model 1935 Hi-Power, selected because it is the standard issue pistol of three allied nations and has been proven to be a strong and dependable weapon.

3. The Smith & Wesson Model 39, selected because of its double action feature, light weight and proven reliability.

4. The Colt Model 1971 Military Pistol, selected for its double action feature, large magazine and improved safety features.

The Colt Model 1971 Military Pistol was selected as the best weapon of the four because it possesses virtually all of the good features and eliminates most of the undesirable features of the other three. The Model 1971's major handicap is that it is so new that its dependability and manner of performance has not been proven in field tests.

Analysis of Ammunition

A comparison of the 9 millimeter and the .45 caliber cartridges revealed that the 9 millimeter is a more

desirable cartridge for the following reasons:

1. Greater potential stopping power at ranges up to approximately twenty-five meters. This is due to its greater velocity below that range.

2. Possesses greater penetration capability due to higher velocity and smaller bullet.

3. A flatter trajectory because of increased velocity.

4. Less recoil because it is a smaller cartridge.

5. Greater accuracy due to flatter trajectory and milder recoil. Less recoil causes less flinching by the shooter and better accuracy to the target.

Multiple projectile cartridges will provide a greater hit probability. The two most promising cartridges being tested are the salvo squeeze bore system and the XM 261 shot cartridge. The salvo squeeze bore stacks three projectiles on top of each other inside the case. The XM 261 is similar to a shotgun cartridge.

Other Factors

Marksmanship training can improve hit probability but must be practiced frequently for proficiency to be retained. Various methods of support have been designed to give added stability and increased accuracy to the shooter. A snap-on wrist lock device seems to be the most practical method that is adaptable for use by a pilot.

A pilot's survival capabilities would be increased

by the flexibility afforded by a variety of ammunition loads. Cartridges carried should include ball, tracer, flare and shot loads.

CONCLUSIONS

The conclusions arrived at as a result of this research are:

1. An automatic pistol is the most suitable weapon available for a U.S. Army helicopter pilot's personal defense weapon.

2. The Colt Model 1971 Military Pistol firing a 9 millimeter cartridge is the automatic pistol most capable of meeting a U.S. Army helicopter pilot's needs. (This conclusion is conditional upon successful completion of field tests.)

RECOMMENDATIONS FOR IMPLEMENTATION

Based on the findings of this research study, the following recommendations are made:

1. That field testing of the durability of the Colt Model 1971 Military Pistol be initiated.

2. Upon favorable conclusion of field tests, the Colt Model 1971 Military Pistol be adopted as the personal defense weapon of issue for U.S. Army helicopter pilots.

3. That future helicopter designs include, in the pilot's cockpit, a convenient location and quick-release means for securing an M-16 or CAR-15 type weapon.

4. That TOE's and TDA's include long range weapons for pilots, in addition to the PDW.

RECOMMENDATIONS FOR FUTURE STUDY

The following areas are recommended for future study:

1. That the salvo squeeze bore principle be specified for further research, testing and evaluation.

2. That research be initiated to determine the feasibility and military application of a combination conventional pistol and Gyrojet type weapon.

3. That an XM 261 type round be tested for use with a 9 millimeter pistol, using the rifled barrel.

4. That testing be initiated to determine the value and military application potential of a wrist-lock stock similar to that referenced in this study.

APPENDIX

AUTHOR'S EVALUATION OF AUTOMATIC PISTOLS

WEAPON (By country of manufacture)	Cartridge Size	Short Recoil or Blowback	Single or Double Action	Magazine Capacity	Weight (in ounces)	Safety Features	Size	Accuracy	Stopping Power	Ease of Employment	Overall Rating	REMARKS
UNITED STATES												
Colt Commander	.45	SR	S	7	26½	P	E	P	E	P	P	Too Light for .45 caliber
Colt Commander	.38	SR	S	9	26½	P	E	A	P	P	P	
Colt Commander	9mm	SR	S	9	26½	P	E	A	A	P	P	
Colt MK IV Srs 70	.45	SR	S	7	39	P	E	A	E	P	P	
Colt MK IV Srs 70	.38	SR	S	9	39	P	E	E	P	P	P	
Colt Model 1911A1	.45	SR	S	7	39	P	E	P	E	P	P	
Colt Model 1971	9mm	SR	D/S	15	35	E	E	E	A	E	E	
Smith & Wesson M39	9mm	SR	D/S	8	26½	A	E	E	A	E	A	
ARGENTINA												
Ballester Molina	.45	SR	S	7	39	P	E	P	E	P	P	Almost identical to 1911A1
AUSTRIA												
Roth-Steyr M1907	8mm	SR	D	10	34	A	E	P	P	P	N	Clip loaded from top
Steyr M12	9mm	SR	S	8	34	P	E	A	P	P	N	Clip loaded from top
BELGIUM												
Browning Hi-Power	9mm	SR	S	13	33	A	E	E	A	A	A	Also made in Canada
Browning F.N.	9mm	BB	S	7	32	P	E	E	P	A	P	
GREAT BRITAIN												
British Colt .455	.455	SR	S	7	39	P	E	P	E	P	P	Modified version of 1911A1
Webley .455	.455	SR	S	7	36	P	E	P	E	P	P	
CZECHOSLOVAKIA												
CZ-47	9mm	SR	D	8	33½	N	E	P	A	A	N	No safety provided
CZ Model 22	9mm	SR	D	8	U	U	E	P	P	A	N	Operation unreliable
CZ Model 1938	9mm	BB	D	8	U	N	E	P	P	A	N	No safety
FRANCE												
M1950	9mm	SR	S	9	28½	A	E	A	A	P	P	Version of Colt Commander
GERMANY												
Model 08 Luger	9mm	SR	S	8	30	P	E	P	A	P	P	
Walther P38	9mm	SR	D/S	8	34	P	E	E	A	A	A	Slow to reload
Walther M PP1929	.380	BB	D	7	23	E	E	P	P	E	P	
Walther M PPK1931	.380	BB	D	7	19	E	E	P	P	E	P	

E=Excellent
A=Adequate
P=Poor
N=Not Acceptable
U=Unknown

WEAPON (By country of manufacture)	Cartridge Size	Short Recoil or Blowback	Single or Double Action	Magazine Capacity	Weight (in ounces)	Safety Features	Size	Accuracy	Stopping Power	Ease of Employment	Overall Rating	REMARKS
ITALY												
Glisenti M1910	9mm	SR	S	7	32	A	E	E	A	P	P	Slow to reload
Beretta M1934	.380	BB	S	7	23½	P	E	E	P	P	P	
Beretta M1951	9mm	SR	S	8	25	P	E	E	A	P	P	
JAPAN												
Nambu Model 57	.45	SR	S	8	34	P	E	P	E	P	P	Modified Copy of 1911A1
Nambu Model 57	9mm	SR	S	8	34	P	E	P	A	P	P	Modified Copy of 1911A1
Nambu Model 1914	8mm	SR	S	8	30	P	E	A	P	P	P	
Nambu Type 14	8mm	SR	S	8	30	N	E	E	P	P	N	Can be assembled without all its parts-dangerous
Nambu Type 94	8mm	SR	S	6	27	N	E	A	P	P	N	Can be fired without pulling trigger-very dangerous
MEXICO												
Mexican Obregon	.45	SR	S	7	38	P	E	P	E	P	P	Closely resembles 1911A1
SPAIN												
Spanish Star Model M	.45	SR	S	7	39	P	E	P	E	P	P	Can fire full automatic
Spanish Super Star	9mm	SR	S	9	36	P	E	A	A	P	P	
Astra Model 400	9mm	BB	S	8	32	P	E	E	P	P	P	
Llama Model 1XA	.45	SR	S	7	38	P	E	P	E	P	P	Exact copy of 1911A1
SWEDEN												
Lahti Model 1940	9mm	SR	S	8	36	A	E	E	A	P	P	
SWITZERLAND												
SIG 210	9mm	SR	S	8	34½	A	E	E	A	A	A	Similar to Browning Hi-Power
RUSSIA												
Makarov (PM)	9mm	BB	D	8	25	A	E	E	P	E	P	
Stechkim (APS)	9mm	BB	U	20	27	U	E	E	P	U	P	Can fire full automatic

E=Excellent
A=Adequate
P=Poor
N=Not Acceptable
U=Unknown

Overall ratings based on acceptability as pilot's side arm.

Weapons below 8mm not listed due to inadequate stopping power.

Ratings reflected in this evaluation are based solely on the personal judgement of the author.

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